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APPARATUS AND METHODS FOR MANAGEMENT OF TEMPORAL PARAMETERS TO PROVIDE ENHANCED ACCESSIBILITY TO COMPUTER PROGRAMS

1. Technical Field:

The present invention is directed to an improved network computer system. More particularly, the present invention provides apparatus and methods for management of temporal parameters to provide enhanced accessibility to computer programs.

2. Description of Related Art:

There has been much emphasis recently in designing computer programs such that the computer programs are more accessible to handicapped or disabled persons. Such efforts to accommodate handicapped persons have been mostly focused on the visual and aural domains. That is, the computer programs are provided with options for changing visual and audio output parameters to make the computer program interface more accessible by the handicapped person.

For example, efforts have been made to allow for enlarging the size and changing the type of fonts used by Internet browser applications and changing the color of the fonts used. In addition, web reader software applications have been devised for reading the content of a downloaded web page to a visually impaired user.

The prior art efforts have not addressed the temporal parameters of computer programs. That is, senior citizens or persons who are cognitively disabled, for example, may be able to see and hear the content of a web page but may require more time to interpret the

visual and audio information from the web page. Thus, it would be beneficial to have apparatus and methods for managing temporal parameters of computer programs to provide greater accessibility to disabled persons.

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SUMMARY OF THE INVENTION

The present invention provides apparatus and methods for managing temporal parameters of computer programs to enhance the accessibility of the computer programs to disabled persons. The apparatus and methods of the present invention provide a mechanism by which computer program data is analyzed to determine the presence of predefined temporal parameters. When the predefined temporal parameters are encountered during the analysis, the values for the temporal parameters are modified based on a user profile. The modified temporal parameters provide a different temporal output for the computer program data from that of the original computer program data. In this way, the temporal output of the computer program data is adjusted to take into consideration the cognitive disabilities of the user.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

Figure 1 is an exemplary block diagram illustrating a network data processing system according to one embodiment of the present invention;

Figure 2 is an exemplary block diagram illustrating a server device according to one embodiment of the present invention;

Figure 3 is an exemplary block diagram illustrating a client device according to one embodiment of the present invention;

Figure 4 is an exemplary block diagram illustrating data flow according to one embodiment of the present invention;

Figures 5A and **5B** are diagrams illustrating an example modification of a temporal parameter of computer program data according to one embodiment of the present invention; and

Figure 6 is a flowchart outlining an exemplary operation of one embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to the figures, **Figure 1** depicts a pictorial representation of a network of data processing systems in which the present invention may be implemented. Network data processing system **100** is a network of computers in which the present invention may be implemented. Network data processing system **100** contains a network **102**, which is the medium used to provide communications links between various devices and computers connected together within network data processing system **100**. Network **102** may include connections, such as wire, wireless communication links, or fiber optic cables.

In the depicted example, a server **104** is connected to network **102** along with storage unit **106**. In addition, clients **108**, **110**, and **112** also are connected to network **102**. These clients **108**, **110**, and **112** may be, for example, personal computers or network computers. In the depicted example, server **104** provides data, such as boot files, operating system images, and applications to clients **108-112**. Clients **108**, **110**, and **112** are clients to server **104**. Network data processing system **100** may include additional servers, clients, and other devices not shown.

Transcoding proxy server **114** is a proxy for the client **108**. The transcoding proxy server **114** receives requests and data from the client device **108** as well as data destined for the client device **108**. The transcoding proxy server **114** may reformat data destined for the client device **108** in accordance with a user profile stored on the transcoding proxy server **114** as well as perform other processing on the received data. The other processing

performed by the transcoding proxy server **114** may include processing associated with a firewall application or the like, as is generally known in the art.

In the depicted example, network data processing system **100** is the Internet with network **102** representing a worldwide collection of networks and gateways that use the TCP/IP suite of protocols to communicate with one another. At the heart of the Internet is a backbone of high-speed data communication lines between major nodes or host computers, consisting of thousands of commercial, government, educational and other computer systems that route data and messages. Of course, network data processing system **100** also may be implemented as a number of different types of networks, such as for example, an intranet, a local area network (LAN), or a wide area network (WAN). **Figure 1** is intended as an example, and not as an architectural limitation for the present invention.

The present invention provides a mechanism by which temporal parameters of computer program data are identified and their values modified to accommodate a disability of a user. What is meant by "computer program data" is any input that is received which is interpreted by a computer to perform a function. For example, the computer program data may be code for generating a web document, conventional computer program code (source, executable or machine), Java bytecode, or the like. For purposes of illustration, the following exemplary embodiments of the present invention will assume that the computer program data is a HyperText Markup Language (HTML) document that is used, in a manner generally known in the art, by a web browser application to generate a web page output on a client device.

The present invention may be implemented entirely within a client device, such as client **108**, or may be distributed between the client device and a server device, such as transcoding proxy server **114**. If implemented entirely on the client device, the present invention may be implemented as a software application on the client device, as a part of a web browser application, as a plug-in component to a web browser application, or the like. Alternatively, the present invention may be implemented in hardware, or a combination of hardware and software, on either the client device or a server device.

In a preferred embodiment, to be described in more detail hereafter, the present invention is implemented on a transcoding proxy server. Thus, with the preferred embodiment of the present invention, a user of a client device may initiate a request for content, such as a web page document, using a web browser application resident on the client device **108**. The request is received by the transcoding proxy server **114** and forwarded to an appropriate server **104** via the network **102**. The appropriate server **104** may be determined, as is generally known in the art, based on header information in the data packets of the request.

The server **104** receives the request for content from the client device **108** and responds with the requested content, such as a web page document. The requested content may include one or more temporal parameters, such as a refresh rate, frame rate, animated GIF timing intervals, banner scroll rates, and the like. The requested content is transmitted by the server **104** to the client device **108** via the network **102**.

The requested content is received by the transcoding

proxy server **114** which then searches the requested content for predefined temporal parameters. The predefined temporal parameters are defined in a user profile stored in the transcoding proxy server **114**. The user profile is retrieved when the requested content is received, based on client device address information stored in the header of the data packets of the requested content. The user profile identifies the temporal parameters for which the transcoding proxy server **114** is to search as well as the modified values for these temporal parameters.

The modified values are values that provide sufficient time, when the requested content is output, so that the user may receive the requested content and interpret the requested content. For example, the temporal parameter may be a refresh rate of a web page document banner advertisement. In such a case, if a user has diminished cognitive capacity, the refresh rate may be set to a longer time interval so that the user is provided with extra time in which to view and interpret the banner advertisement.

Based on the user profile stored on the transcoding proxy server **114**, the transcoding proxy server **114** searches the requested content for the predefined temporal parameters and modifies the values for these temporal parameters as they are encountered. The values for the temporal parameters are modified to be the values set forth in the user profile. The modified requested content is then transmitted to the client device **108**. In the case of a web page document, when the client device **108** receives the requested content, the web browser application on the client device receives the web page document including the modified temporal parameters, and

outputs the web page document using a web browser application, in a manner generally known in the art.

Thus, the present invention provides a mechanism by which temporal parameters associated with requested content, i.e. computer program data, may be modified to accommodate disabled users. The present invention may be implemented on either a server or a client device. A server implementation is chosen as a preferred embodiment due to the ease of distributing and updating the present invention using servers rather than distributing the present invention to each individual client device. However, the distribution of the present invention to each individual client device is well within the scope of the present invention.

Referring to **Figure 2**, a block diagram of a data processing system that may be implemented as a server, such as server **104** or transcoding proxy server **114** in **Figure 1**, is depicted in accordance with a preferred embodiment of the present invention. Data processing system **200** may be a symmetric multiprocessor (SMP) system including a plurality of processors **202** and **204** connected to system bus **206**. Alternatively, a single processor system may be employed. Also connected to system bus **206** is memory controller/cache **208**, which provides an interface to local memory **209**. I/O bus bridge **210** is connected to system bus **206** and provides an interface to I/O bus **212**. Memory controller/cache **208** and I/O bus bridge **210** may be integrated as depicted.

Peripheral component interconnect (PCI) bus bridge **214** connected to I/O bus **212** provides an interface to PCI local bus **216**. A number of modems may be connected to PCI bus **216**. Typical PCI bus implementations will support

four PCI expansion slots or add-in connectors. Communications links to network computers **108-112** in **Figure 1** may be provided through modem **218** and network adapter **220** connected to PCI local bus **216** through add-in boards.

Additional PCI bus bridges **222** and **224** provide interfaces for additional PCI buses **226** and **228**, from which additional modems or network adapters may be supported. In this manner, data processing system **200** allows connections to multiple network computers. A memory-mapped graphics adapter **230** and hard disk **232** may also be connected to I/O bus **212** as depicted, either directly or indirectly.

Those of ordinary skill in the art will appreciate that the hardware depicted in **Figure 2** may vary. For example, other peripheral devices, such as optical disk drives and the like, also may be used in addition to or in place of the hardware depicted. The depicted example is not meant to imply architectural limitations with respect to the present invention.

The data processing system depicted in **Figure 2** may be, for example, an IBM RISC/System 6000 system, a product of International Business Machines Corporation in Armonk, New York, running the Advanced Interactive Executive (AIX) operating system.

As mentioned above, the server device depicted in **Figure 2** may be used as a transcoding proxy server, such as transcoding proxy server **114** in **Figure 1**. As a transcoding proxy server, the processor **202** or **204** receives a request for content from a client device via modem **218** or network adapter **220**. The processor **202**, for example, performs any necessary processing on the request

for content and then forwards the request to the network **102** via the network adapter **220**.

The request for content is then routed through the network **102**, from computing device to computing device, based on address information included in the header of data packets of the request for content. The request for content eventually arrives at the content server **104** which performs the necessary processing on the request, as is generally known in the art, and responds to the request with the requested content.

The requested content is routed back to the transcoding proxy server via the network **102** based on address information stored in headers of the data packets of the requested content. The processor **202**, for example, of the transcoding proxy server receives the requested content via the network adapter **220**. The processor **202** performs processing on the requested content and then forwards the requested content to the client device via one of the modem **218** or the network adapter **220**.

The processing performed on the requested content includes a search for predefined temporal parameters and replacement of the values of these predefined temporal parameters. Such processing includes retrieval of a user profile from local memory **209** based on client device identification information received in the header of the request for content. The user profile defines the temporal parameters that are to be searched for in requested content for this user as well as the preferred values for these temporal parameters.

Based on the user profile, the processor **202** searches the requested content for the identified temporal parameters in the user profile and replaces the values in

the requested content for these temporal parameters with the preferred values in the user profile. The modified requested content is then forwarded to the client device via one of the modem **218** or the network adapter **220**. In this way, the transcoding proxy server modifies requested content to take into consideration the cognitive disabilities of the user requesting the content.

With reference now to **Figure 3**, a block diagram illustrating a data processing system is depicted in which the present invention may be implemented. Data processing system **300** is an example of a client computer. Data processing system **300** employs a peripheral component interconnect (PCI) local bus architecture. Although the depicted example employs a PCI bus, other bus architectures such as Accelerated Graphics Port (AGP) and Industry Standard Architecture (ISA) may be used. Processor **302** and main memory **304** are connected to PCI local bus **306** through PCI bridge **308**. PCI bridge **308** also may include an integrated memory controller and cache memory for processor **302**. Additional connections to PCI local bus **306** may be made through direct component interconnection or through add-in boards.

In the depicted example, local area network (LAN) adapter **310**, SCSI host bus adapter **312**, and expansion bus interface **314** are connected to PCI local bus **306** by direct component connection. In contrast, audio adapter **316**, graphics adapter **318**, and audio/video adapter **319** are connected to PCI local bus **306** by add-in boards inserted into expansion slots. Expansion bus interface **314** provides a connection for a keyboard and mouse adapter **320**, modem **322**, and additional memory **324**. Small computer system interface (SCSI) host bus adapter **312** provides a

connection for hard disk drive **326**, tape drive **328**, and CD-ROM drive **330**. Typical PCI local bus implementations will support three or four PCI expansion slots or add-in connectors.

An operating system runs on processor **302** and is used to coordinate and provide control of various components within data processing system **300** in **Figure 3**. The operating system may be a commercially available operating system, such as Windows 2000, which is available from Microsoft Corporation. An object oriented programming system such as Java may run in conjunction with the operating system and provide calls to the operating system from Java programs or applications executing on data processing system **300**. "Java" is a trademark of Sun Microsystems, Inc. Instructions for the operating system, the object-oriented operating system, and applications or programs are located on storage devices, such as hard disk drive **326**, and may be loaded into main memory **304** for execution by processor **302**.

Those of ordinary skill in the art will appreciate that the hardware in **Figure 3** may vary depending on the implementation. Other internal hardware or peripheral devices, such as flash ROM (or equivalent nonvolatile memory) or optical disk drives and the like, may be used in addition to or in place of the hardware depicted in **Figure 3**. Also, the processes of the present invention may be applied to a multiprocessor data processing system.

As another example, data processing system **300** may be a stand-alone system configured to be bootable without relying on some type of network communication interface, whether or not data processing system **300** comprises some

type of network communication interface. As a further example, data processing system **300** may be a Personal Digital Assistant (PDA) device, which is configured with ROM and/or flash ROM in order to provide non-volatile memory for storing operating system files and/or user-generated data.

The depicted example in **Figure 3** and above-described examples are not meant to imply architectural limitations. For example, data processing system **300** also may be a notebook computer or hand held computer in addition to taking the form of a PDA. Data processing system **300** also may be a kiosk or a Web appliance.

The client device depicted in **Figure 3** may be used to send requests for content and receive requested content using a web browser application in a manner generally known in the art. The requested content that is received may be modified by a transcoding proxy server from that sent by the content server, as described above.

Alternatively, the functions described above as being performed by the transcoding proxy server may be implemented in the client device itself. For example, the searching for temporal parameters in the requested content and replacement of the values of the identified temporal parameters may be performed by a temporal parameter adjustment application resident on the client device. The temporal parameter adjustment application may be a stand alone application, a portion of a web browser application, a plug-in application to a web browser application, or the like. With such an embodiment, the user profile described above may be stored on the client device so that it is readily retrievable by the temporal parameter adjustment

application.

Figure 4 provides an exemplary block diagram to illustrate the data flow between the client device, transcoding proxy server, and the content server in accordance with a preferred embodiment of the present invention. The preferred embodiment assumes, for illustration purposes, that the client device sends a request for a HyperText Markup Language (HTML) document, although the present invention is not limited to such requested content. As shown in **Figure 4**, the client device **410** generates and transmits a document request **415** to the transcoding proxy server **430**. The transcoding proxy server **430** performs any necessary processing on the document request **415** and forwards the request to the content server **420**. The content server **420** responds to the document request by transmitting the requested document **425** to the transcoding proxy server **430**. The requested document **425** sent from the content server **420** contains a temporal parameter **428**.

The transcoding proxy server **430** receives the requested document **425** with the temporal parameter **428** and searches the requested document **425** for the temporal parameter **428**. The transcoding proxy server **430**, having found the temporal parameter **428**, replaces the value for the temporal parameter **428** with a value designated in a user profile for the user of the client device **410**. The resulting document **435** contains a modified temporal parameter **438**. The resulting document **435** is transmitted to the client device **410**. Thus, the resulting document **435** contains the same content as the document **425** transmitted by the content server **420** only with a

modified temporal parameter **438**.

Figures 5A and **5B** illustrate an example of the use of the present invention with a requested HTML document. **Figure 5A** represents an HTML document as it is transmitted by the content server. As shown in **Figure 5A**, the HTML document includes a HyperText Transfer Protocol (HTTP) refresh parameter **510** that has a value **515** set to a value of five seconds. As is generally known in the art, HTTP refresh rates are used to automatically refresh the content of a web page after a given time interval. In this way, a web page's content may be dynamically modified by a supplier of the web page or the content may be modified by referencing content from another web location.

HTTP refresh rates are typically chosen to be between one and five seconds for non-disabled users by many programmers. Thus, the five second refresh rate in the HTML document of **Figure 5A** may not be sufficient for a user that suffers from a cognitive disability.

As described above, the present invention provides a mechanism by which a cognitively disabled user may have the temporal parameters of requested content modified to take into consideration the disability of the user. The resulting HTML document is shown in **Figure 5B**. As shown in **Figure 5B**, the value **520** for the HTTP refresh parameter **510** has been modified to ten seconds. Thus, a cognitively disabled user is provided with twice as much time between refreshes of the web page to interpret the information being displayed.

It has been stated above that the user profile includes a preferred value for the predetermined temporal parameters. The preferred value may be the actual value

to which the temporal parameter should be set. Alternatively, the preferred value may be a multiplier for multiplying the original value for the temporal parameter. For example, the preferred value in the examples shown in **Figures 5A** and **5B** may be the actual value of "10" or it may be a multiplier, such as "2". In even more complex embodiments of the present invention, mathematical functions may be provided for calculating the modified value for the temporal parameter based on the original value for the temporal parameter as well as other parameters, based on the particular implementation selected.

Other mechanisms for modifying the temporal parameter values may be used without departing from the spirit and scope of the present invention. For example, the user of the client device may register with a transcoding proxy server, or with the client device, to thereby establish a user profile on the transcoding proxy server. During the process of registering, the user may provide information identifying the user's disability. The user profile may include only an indicator of the user's disability rather than a list of the temporal parameters and their associated preferred values. Based on the user's disability, the present invention may determine which temporal parameters should be searched for and their values adjusted as well as the modified values for these temporal parameters.

For example, the user may register with the transcoding proxy server and indicate that the user is 76 years old. Thus, due to the user's advanced age, the user may require additional time to interpret information provided to the user. Accordingly, the present invention may determine that the HTTP refresh time interval should

be multiplied by 2, the banner scroll rate should be one half that of the original banner scroll rate, and the animated GIF timing intervals should be 7 seconds. Alternatively, the user may indicate that he/she has mild retardation. Accordingly, the present invention may determine that the HTTP refresh time interval should be multiplied by 3, the banner scroll rate should be one third that of the original banner scroll rate, and the animated GIF timing intervals should not be changed.

The determination of which temporal parameters to search for and modify, as well as the modified values for these temporal parameters, may be based on empirical data, for example. Moreover, the present invention may employ a neural network, expert system, rule-based system, or the like, to make the determination of which temporal parameters to search for and modify as well as the modified values for these temporal parameters.

The above embodiments of the present invention have been described in terms of a web browser application retrieving web page content from a content server. However, the present invention is not limited to such embodiments. Rather, the present invention may be applied to any computer program data that may include temporal parameters. The computer program data may be obtained from another computing device, such as a server, or may be resident in a local storage device, for example.

Thus, the present invention may be embodied as an application on a client device that is executed on computer program data to adjust the temporal parameters in the computer program data in view of the disability of the user. The present invention is not limited to any particular computer language and may be applied to Java

code, C++, HTML, Wireless Device Markup Language (WDML), and the like.

Figure 6 is a flowchart outlining an exemplary operation of the present invention. The operation shown in **Figure 6** may be performed in a transcoding proxy server or in a client device. As shown in **Figure 6**, the operation starts with receiving computer program data (step **610**). The user profile is retrieved (step **620**). A search of the computer program data for the predefined temporal parameters is performed (step **630**). The values for the identified temporal parameters are then modified in the computer program data based on the preferred values set forth in, or calculated based on, the user profile (step **640**). The modified computer program data is then output (step **650**) and the operation ends.

Thus, the present invention provides a mechanism for adjusting temporal parameters in computer program data to take into consideration the disabilities of a user. In this way, a user that may have diminished cognitive capacity may be provided with additional time with which to interpret information provided to him/her by the computer program data.

It is important to note that while the present invention has been described in the context of a fully functioning data processing system, those of ordinary skill in the art will appreciate that the processes of the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention applies equally regardless of the particular type of signal bearing media actually used to carry out the distribution. Examples of computer readable media

include recordable-type media, such as a floppy disk, a hard disk drive, a RAM, CD-ROMs, DVD-ROMs, and transmission-type media, such as digital and analog communications links, wired or wireless communications links using transmission forms, such as, for example, radio frequency and light wave transmissions. The computer readable media may take the form of coded formats that are decoded for actual use in a particular data processing system.

The description of the present invention has been presented for purposes of illustration and description, and is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.